



A statistical analysis of the correlation between Large Igneous Provinces and lower mantle seismic structure

Jacqueline Austermann, Bryan T. Kaye, and Jerry X. Mitrovica

Harvard University, Cambridge, MA, United States (jacqueline.austermann@gmail.com)

Large Igneous Provinces (LIPs) lie approximately above the margins of the African and Pacific Large Low Shear Velocity Provinces (LLSVPs) in the deep mantle. This spatial correlation has been used to argue that a mechanism exists whereby plumes are preferentially generated at the margins of LLSVPs. We perform a Monte Carlo based statistical test to assess the uniqueness of this conclusion. We define a null hypothesis that LIPs are preferentially generated along margins of LLSVPs. We then test the alternative (and less restrictive) hypothesis that plumes are generated in areas where the shear wave velocity is slower than average (these areas include LLSVPs). The statistical test is performed for four different tomography models and four different reference frames for LIP reconstruction.

Our results demonstrate that the locations of LIPs are statistically significantly correlated with both the margins of LLSVPs and with regions of slower-than-average shear wave velocity in the deep mantle. We also demonstrate that, from a statistical point of view, the null hypothesis is indistinguishable from the alternative hypothesis. This suggests that LIPs might only be correlated with margins of LLSVPs because they rise from regions of slower-than-average velocity, and not because these margins act as a zone of plume generation.

This argument is further strengthened by noting that there are other substantial uncertainties that have not been quantified, such as the lateral deflection of plumes during their ascent and incomplete knowledge of LIP locations with respect to the corresponding plume impact site on the base of the lithosphere.

Finally, we also test the correlation between LIPs and the horizontal gradient in velocity perturbations and find, given the uncertainty implied by different tomography models, that there is no statistically significant correlation.